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Automation in the USSR

As in the United States, automation, or the automatization of the manufacturing process, has received a great deal of public attention in the USSR. The directives which the Nineteenth Congress of the CPSU gave for the fifth Five Year Plan included at least half a dozen references to automation.

In the recent reorganization of the State planning mechanism, there has been established a State Committee for the Introduction of New Technology into the Economy (GOSTEKNNIKA), attached to the USSR Council of Ministers. One of the principal initial tasks set for this committee, after its formation in May, 1955, was the working out of plans for the mechanization and automation of the most important branches of industry. GOSTEKNNIKA has the right to control the activities of ministries and department in the introduction into the national economy of advanced industrial technology. The Committee also has inspection rights in order to insure implementation of its instructions. A similar Committee was in existence between 1948 and 1951.

Over the course of the past several years the technical literature and the public press of the USSR have abounded with articles describing the successes and the shortcomings of the drive to achieve the new technology. THERE ARE

several hundred such articles. In substantive technological and economic content, this massive literature is very similar to the U.S. trade and popular literature on the same subject.

In a lengthy report "On Tasks for the Further Development of Industry, Technical Progress, and Improving the organization of Production" at the Plenary Sessions of the Central Committee of the CPSU on July 4, 1955, Bulganin once

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more heavily emphasized the role that automation must play in the future. Nearly half of the report dealt with some aspect of mechanization (including automation) of production.

[As]^R recently [as last week] the Minister of Heavy Machine Building, N.S. Kazakov, was dismissed. The week before that the Minister of Automobile, Tractor, and Agriculture Machine Building, S.A. Akopov, was dismissed. Both had been severely berated for their failure to introduce modern technology, including automation, in the plants controlled by their Ministries.

[It is hard to pick up a copy of the FBIS Daily Report or any other report of speeches in the USSR without encountering some references to automation.]

What's Automation?

Before progressing further, it will be well to define our terms. Automation, as the term is used in the American literature, has three different definitions. The first of these came from the originator of the term - the Ford Motor Company. By Ford's definition, automation is the use of automatic materials handling equipment between machine tools. This definition limits the use of the term to the mechanical processing industries.

A second narrow definition limits automation to those processes in which some characteristic of the product being produced (for example its size or temperature) is used to control the production process. In the language of the servo-mechanisms engineer, this is the application of closed-loop feedback control systems to production processes.

A third definition, somewhat broader than either of the other two and including both of them, is in common use. By this definition, automation involves the use of any machine, device, or the like which replaces an animate

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operator as the controlling mechanism in a production process. Since this definition corresponds to Soviet usage as well as the most widely accepted usage in the United States, it will be the definition used throughout this report.

How far has the USSR progressed?

Any attempt to assess the progress of the USSR in a field as broad as automation is, at the present state of our knowledge, quite subjective. The growth of the electronics industry and the instrument industry are both related to the growth of automation. But, because of the relation of these industries to the guided missile and other armament control systems, neither industry uniquely measures the growth of automation. An attempt to quantify the growth of automation is in reality an attempt to measure in the aggregate the rate of change in the state of industrial technology. To date we have devised no method of making such a measurement.

In the research and development stages, it can be said that the USSR has at least kept pace with the West. In some special fields, such as non-linear servo theory, Soviet scientists have surpassed western scientists. It is estimated that some 150 scientists associated with the Institute of Automatics and Telemechanics of the Academy of Sciences are working on the problems of automatic control. It is probable that the greatest efforts of this group are directed toward military problems, with the industrial applications taking second place. A group of about the same size in the Institute of Machine Sciences is also working on similar problems. Regardless of the present allocation of effort as between military and industrial applications within the Institutes of the Academy of Science, however, the long run advances in industrial

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use are most nearly related to the total effort. This is true because the technology of control and the facilities for the production of control equipment may be in large measure interchangeable between military and non-military application. Any effort going into either will, therefore, ultimately benefit both. In the short run -- that is, within a period of a year or two -- industrial and military applications are competitive.

A survey of the industrial applications of automation to date demonstrates that Soviets have placed high priority on heavy industry applications. The body of literature referred to above indicates that they are not satisfied with the progress to date. A brief reference to two industries - chemicals and automotive - which highlight two different aspects of automation growth in both the USA and the USSR follows:

The Chemical Industry and Automation

The chemical processing industry has been the leader in applications of automatic control of production. In the chemical processing industry the Soviets are behind the United States in the extent of automation now in being. On the other hand, the range of applications indicates that the lag is quantitative not qualitative. When circumstances have required that they advance beyond American technology, they have demonstrated that they are capable of designing and producing original automatic equipment. In the automatic production of sulphuric acid from iron pyrites, for example, the Soviets have developed their own automatic technology. Because of an ample supply of free sulphur, American industry has had no occasion to use this process.

The point to be emphasized in the chemical industry is that automation is not a new postwar phenomenon but has progressed with the technology of the

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industry and is indistinguishable from the remainder of the technology of the industry. This is the case in the USSR as in the United States with time lags and quantitative differences that roughly correspond to the relative states of industrialization.

Automation in the Automotive Industry

In the automotive industry, on the other hand, automation is largely a post-war development. As indicated above, the term was itself devised by the automotive industry of the U.S. to describe the automatic materials handling devices being installed in machining plants of the industry in the late 1940's. The conditions of large scale production of standardized parts (e.g., the engines and chassis of American automobiles in the post-war period) are paralleled in the USSR in the manufacture of trucks and their component parts. Although the production rates and products fall short of those in the U.S., Soviet standardization of components in some cases calls for large scale production of individual components. Automation has proceeded extensively in both countries, with the USSR lagging in extent of application for the most part.

In at least one aspect of automotive production, however, the Soviets have gone farther than American manufacturers. By 1951 they had built and were operating an automatic plant for the production of pistons. This plant was described as automatic from ingot to packaged pistons. A second plant, parallel to and with improvements on the first, was installed and operating by the following year. American manufacturers of pistons, on examining the plans for these plants indicated that the Soviets had gone further in eliminating transport labor than any U.S. manufacturer would have gone under the circumstances. They further indicated that piston design is so diversified and so rapidly changing in the U.S. that they could not afford to invest so much in an automatic plant which would become obsolete so soon. With enforced standardization and centralized control of model changes, the USSR could economically carry automation further than could any U.S. manufacturer.

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A recent photograph taken in the piston plant, however, shows a worker feeding a machine at one station that was supposed to be fed by an ingenious magazine device. It appears from this photograph that the actual construction of the automatic line did not eliminate all the workers indicated in the technical description and that, in fact, the piston factory while still more advanced than American plants, did not so far outstrip American Technology as was at first believed.

The lesson of the automotive industry is that the Soviets are technically capable of matching the automatic machine line applications of American industry. Where local conditions warrant, they appear to have the ability to carry mechanization further than ^{THE US HAS} (we have) done. They have gone further in producing standardized machine components for assembly into automatic lines. The principal limitation is the ability to produce as much equipment as they would like to produce. That is, the limitations are economic not technological.

What Problems Do the Soviets Expect to Solve Through Automation?

For the most part the Soviets view automation as we do; that is, as one of several means for reducing the costs of production. But there are some differences in the intensity of their feelings because of certain differences in the two economies and institutions. Faced with a decrease in the rate of growth in some industries in the last five years, many attempts have been made to increase productivity. It appears that additional manpower can no longer be drained from the agricultural sector. There is, therefore, an approaching absolute shortage of industrial manpower. Increases in output must come from increased productivity henceforth. Reports of failure

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to meet the plan for increased productivity have been frequent while plans for increases in the industrial labor force have been overfulfilled. Automation is now viewed, therefore, as a factor that must take over the job previously done by an expanding industrial work force.

At least one other problem intensifies the Soviet interest in automation. The elimination of the distinction between mental and manual labor is an important ideological tenet. Automation can have the effect of eliminating the unskilled laborer and elevating all workers to the level of skilled maintenance men or engineers. There is evidence that this is one concern of the USSR. In 1949 G.A. Shaumyan wrote a book entitled Avtomaty dealing with the theory and practice of automatic machines and automatic lines. On 7 July 1950 there was convened an extended session of the Scientific-Technical Soviet of the Experimental Scientific Research Institute of Metal Cutting tools. Professor Shaumyan's book was discussed at some length by the 167 representatives of 28 organizations present. The book was criticized for advocating the design of machines to reduce the needs for skilled and unskilled workers and the elimination of the latter. In addition, Shaumyan was criticized for designing machines for maximizing output rather than designing machines to produce the quantities called for by plan. The earlier book was declared unsuitable and was replaced in 1952 by a text which is believed to incorporate the approach advocated in these meetings.

In the USSR, in other words, automation has an ideological as well as an economic appeal. It is not known how strong a role the ideological aspect plays in the growth and exhortation to further growth of automation. It is clear that the pressure to increase output of heavy industry by whatever means possible is very great and that the leadership views automation as only one

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means of achieving this goal.

This position is made quite clear by Bulgamin's recent report cited above. In addition to pointing out the shortcomings in the extension of automation, he points out that plant specialization will yield larger scale output and increase the efficiency of industrial production; that more effective utilization of machinery already in place offers tremendous opportunities for increases in output; that better planning and organization of industry to reduce bottlenecks and to stabilize the tempo of work flows can contribute greatly to the increase of output with existing capacities; and that increased standardization of products and production equipment offer opportunities for additional economics.

As the adoption of automation progresses in the USSR, several additional problems should be watched. (1) As indicated above, automation may increase the needs for highly skilled production workers while decreasing the need for unskilled and semi-skilled workers. This change implies the need for intensified training of electronic maintenance skills and other technical skills. The Soviets are aware of this problem and may be able to prevent its becoming a serious bottleneck.

(2) Automation is conceived as one means of increasing output per man-hour. Particular notice should be paid to those industries which are most rapidly converting their technology to automation in order to determine if, in fact, the expected changes in productivity are forthcoming.

(3) There is no clear notion of whether automation will require more or less capital investment per unit of output than is required by less advanced technology. Present knowledge of capital-output ratios and their significance is relatively slight. Studies of the U.S. economy seem to point

to decreased capital needs per unit of output in most industries since about 1920. To date we have not been able to measure similar trends in the USSR. It will be important for us to know whether automation may be expected to be capital-saving as well as labor-saving.

(4) A final problem, the introduction of additional rigidities into the economy, merits careful study. This problem is common to all highly mechanized economies. Much production machinery being installed in automatic lines or automatic plants is highly specialized with but limited flexibility in the volume of output it is capable of handling or in the variation in product it can produce. Accordingly, once a decision is made to build this type of automatic plant of a given size to produce a given product, it will be much more difficult to step up the rate of output in the future or to change to some other product.

[In a speech last January to the Industrial College of the Armed Forces]
Recently, General Manager, Defense Operations Division, Chrysler Corporation, stated that "with automation today a lot of the machine tools use in the industry aren't going to be available come world war I, because an automated cylinder block line is such that it takes cylinder blocks only." To the extent that this becomes a general condition in industry (which is not presently the case) there may be set up an industrial system for defense production quite independent of the remainder of industry. To a certain extent, the assignment of plants to the Ministry of Defense Industry is a partial step in this direction.

On the other hand, a contrary possibility exists. Some design and application work has been completed, at least in the U.S., on the programming of a computer to operate and control general purpose machinery. General Electric Co. and the Servomechanisms Laboratory of M.I.T. have each developed practical

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application of this idea and some production of this equipment is in process. This avenue points to reduced rigidity in industrial organization and output. We need to watch the trends of both types of development (i.e., rigid special purpose automatic lines and flexible general purpose automatic equipment), determine the implications of each.

In summary it should be pointed out again that automation is not a new phenomenon; it is a phenomenon separate from the broad advance of mechanization. The USSR appears to be capable of handling any of the theoretical or practical problems of mechanization, though not necessarily at the speed they would like. They can be expected to proceed with automation as rapidly as their other commitments permit. At the same time they will take whatever other measures are possible to increase output. There is, however, an ideological as well as a practical (labor shortage) reason for their interest in automation.

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